THE SAND-HOPPER BEES.

By TARLTON RAYMENT.

You will remember that the maker of fine purses, the wild-bee, *Euryglossa*, dwells on the very face of the cliffs which hem in the waters along the eastern shore of Port Phillip Bay. This natural wall, then, receives the full brunt of the broiling summer sun.

In winter, the spray and spume from the sea sweep up over the cliffs in misty gushes that follow each other in irregular succession as determined by the caprice of the wind. The ferocity of the "weather" erodes all soft soil, and, as I have already described the cliff-bees love the naked escarpments that are as hard as sandstone.

But the honey-gatherers that I now wish to talk about are the "Sand-hoppers," *Halictus victoriellus*,* Ckll., that shun the exposed positions, and never seek the cliff-face, with its alternate heat and cold and wind. They nest in the top, in the shelter of the dense Tea-tree[1] and Coast Wattle.[2] There the ground is clad with the golden-flowered Capeweed,[3] the "Boobialla,"[4] and also much green verdure, including a kind of sweet-smelling wild Spinach. There is, too, the yellow flowered *Melilotus* in abundance.

In through the beauty of the unique Tea-tree growth, wind narrow paths that are firm enough when wet, but which in dry weather soon tramp into a light-grey loose sand. Picnic parties from the city roam over the coast, especially on holidays, and the paths become as soft as dry flour, so fine are the grains of quartz.

When the top of the ground is damp it is dark in colour, almost black, and I think the sombre hue might be explained by the decaying of the vegetation that crowns the cliffs. I am curious, and scrape away some of the black top-land for a few inches until I uncover a thick stratum of white sea-shells, all of which lie flat; never an one on edge. Then a thin layer of charcoal-like debris, which is very black indeed. Then more bands of shells and charcoal, perhaps for three feet down. The lime is soft, and crumbles quickly between my fingers; it may have been burnt ages ago, when fingers blacker than mine picked out the tasty morsels from the freshly roasted shells.

*This species is very close to *H. pulvitectus*, Ckll., recorded from Tasmania.

1. *Leptospermum laevigatum.*
2. *Acacia longifolia*, var. *sophorae.*
3. *Cryptostemma calendulaceum.*
4. *Myoporum insulare.*

However, the old residents of the shore tell me that the aborigines were accustomed to congregate along the grassy places, to perform certain rites that included the cooking of shellfish from the near-by rocks. There are large areas of alternate layers of shells and burnt debris, and the corroborees must have been spread over a very lengthy period to account for such a huge deposit. Of this I am sure, where the burnt matter is uncovered the ground is very dark.

It is all very interesting, and the problem is worth investigating, but my paths are sharply defined, though in places are right in among the Wattles, so that I get brushed with the foliage as I push through. Now, I have walked these winding tracks for years, and I possess sharp eyes, but I had many disappointments before I found the nests I sought.

It is a spring day in September, and I am fortunate—also patient, and I lean one arm on a bent tree-limb to rest and observe at length.

I am rewarded.

You see, it is yet too early for the summer visitors to tramp the friable ground into flour, and right at my feet I perceive many dozens of tiny grey-black bees fossicking for a shaft-mouth in the centre of a cone of loose sand. These do not find their home sites quickly, though they search diligently over an area of a foot or so. They then dive suddenly into a cavity close to a grass-root. They are females, loaded heavily, either with Cape-weed gold, or else the cream pollen of the pink "Pigface." One searched the tiny pink funnel-flower of the Onion-weed.

Fortune often comes with a lavish hand, and though I have spent years in unsuccessful search, here are nests in abundance. Fabre said that his untiring patience certainly deserved a reward, consequently, he reaped his harvest. Am I any less entitled to succeed? Three years of honest peering into banks of sand, of clay, of sandstone, of loam, under grass roots, in amongst the tangle of the Wattle and the Tea-tree, under the clear blue—the intensely blue sky, the summer sun, in the chill autumnal wind, as the spring showers came sweeping across the purple blue of the Bay.

And success kept ever hovering ahead, just beyond my grasp. To-day fortune comes and spreads her gifts in a stream from her overflowing cornucopia. The nests of two long-sought species are right at my feet, while I stand idly resting.

Close at hand are a few nests of another species, one almost as huge as the Honey-bee. It is an Australian *Paracolletes*, but though I have often caught these bees I had not previously identified the nests. I shall rectify the omission.

The collection of bees in Melbourne's Museum is a limited one and many are unnamed. My collection will have to be forwarded to Professor Cockerell, of Colorado, U.S.A., for identification. No entomologist has taken up the study of the life histories of the Australian bees, so that I find myself bereft of all companionship. I look up Froggart's book on Australian Insects: "Nothing is known of the habits of the Australian *Halicti*"!

To-day I notice quite a number of females searching among loose sand, and some succeed in finding the mouths of the shafts. Since the excavated material is formed into a mound, and is very loose, I do not know if these bees cover the entrances to conceal them, or whether the loose sand just drifts over the hole with the lightest zephyrs that blow. However, most of the entrances are closed at one period or another.

The tunnel is not lined in any way, and although I saw a few pollen-laden females pass in, I could not find anything other than a number of pupae cases, each a little over a quarter of an inch in length, probably of some fly. I brought some home to mature, but I do not think at present these are reared on the bees' stores. Six to eight square feet are occupied by the bees' nests, and while I was unable to discover a pudding or cells, I did find plenty of pupae of a brownish-pink colour, and one pupa of a very dirty yellowy white, the abdomen being pinched into a point at the end. They were found about 9 inches down, and scattered through the earth. [Later these developed into large flies that have no relationship with the bees' nests.]

The October days are very fine, and I visited my bees every day. Sometimes all of the shafts were closed with loose sand, and since there is always much foot traffic, I am again unable to say whether the closing is due to human feet or to those of the insects. I attempted to dig one out, but it went down over twelve inches, and owing to the looseness of the ground I was unable to follow the burrow any deeper. Moreover, I do dislike digging under the scrutiny of curious people, passing visitors, and employes of the municipal council.

The head-gardener is a good friend of mine, so that when I am rewarded with a glimpse of a wild-bee's nest

in the loose sand of his flower beds, I say, "Will you please let me know when you wish to dig this bed. That tiny black hole is the mouth of the shaft that leads to the nursery of a wild-bee. I want to study it." The gardener plucks a near-by twig and thrusts it into the ground to mark the nest.

My notes read: October, 9th day, and it is blowing "great guns" from the north, and though it is yet spring, it is a dry devastating wind that turns all the Cape-weed heads to the south. Not a single honey-gatherer is to be seen, and I am dismayed. It is a most uncomfortable day. True, there is no dust such as is drenching the inland northern suburbs of Melbourne, but the Tea-tree wrenches at the soil, and the flowers suffer intensely. The water is calm inshore, as the breeze is off the land, but out a mile or so there is a white-capped cross sea.

I said there is not a bee in sight, and the Sand-hoppers have almost every entrance closed. Of course, the wind could do that quite easily. I have a spade with me today, also a strong knife and a length of white string.

I blow away a patch of loose sand, equalling the area of a half-penny, and uncover a tiny black aperture. I then pass down my thread as far as it will go, and find that eight inches is all that I can plumb. You see, the soil on the cliff-top is so friable that fine, tinned wire encounters but little resistance in the soft ground, so that it will disappear in any direction, and when I attempt to follow it down, why! I astonish myself by delving clean away from the bee's shaft, finding nothing at all.

I pass down the white string, which shows in dark contrast to the dark soil. The next operation is to sink, say, eighteen inches deep at the side of the shaft. I then bring into play my knife, and carefully pare away slice after slice of earth until I uncover my white, guiding thread. The removed material drops away, and does not bother me by falling in and obliterating the object of my search.

Down I go, very carefully indeed, for as far as I can discern, there is absolutely no lining to the shaft, which drops away obliquely. I must be particularly dexterous, or I may damage the ———! I am at the bottom, where the shaft turns, and terminates in a tiny chamber about a quarter of an inch in length.

There is no sign of any bee. The inside of the chamber appears slightly darker than the surrounding earth, as though it had received the very thinnest coating of some liquid that had dried just a fraction harder than the

original ground. In the room is a solitary orange coloured pudding, about as large as the head of a match, or perhaps a little smaller. It is wonderfully smooth, and has just a suspicion of shininess; it is very firm, and seems to be softer on the outside. It is undoubtedly of Cape-weed pollen, for that is the only plant at present in bloom. Indeed, there is no other local plant that yields similarly bright granules, if we except the "Flat-weed," *Hypochaeris radicata*, a dandelion-like flower that is at its best in autumn.

I decided that the mouth of the shaft led to the Sand-hopper's nest because I detected a few Cape-weed granules that had been scraped from her legs by obstructing grass stalks, and that reminded one of how the sheets of perforated metal—used by the commercial apiarists to confine the queen to the brood-chamber of the hive—scrape off much of the Honey-bee's load as she struggles through the zinc barrier. I have seen quite a heap of the vari-coloured pellets of the precious meal lying about the doorways of busy colonies, and I have always opposed the use of "queen excluders," if only for the reason that they caused a serious loss of food, to say nothing of the bees's time and energy.

However, being aware of that effect on the Honey-bee has often helped me to discover the entrances to the Sand-hopper's nests. Some one may take me to task for my choice of this name, so I will tell you how I came to christen this bee.

When I found the first colony, the holes were spread out over an area of about five square feet, and it was interesting to watch these bees "flip" down, remain perfectly still for a moment, then "flip" again, when they alighted a foot or so away. It seems that this bee does not settle close to its shaft, but makes several attempts before being successful, so that a number are alighting while others are taking wing; they appear to be hopping instead of flying.

This is especially the case when they are well dusted with golden pollen. Should the bees have no granules, they are more difficult to see, for they are as dark as the grey of the soil; moreover, they are small in stature, for the length is about a quarter of an inch.

In the centre of a small, ovoid chamber is the pudding of the Cape-weed pollen kneaded with honey. It is beautifully round and smooth, and is without blemish, like a polished lentil. In one nest I find a larva on its cake. The baby bee is only 1-16th of an inch in length,

and must be only a few hours old, for, even with a magnifying glass of 24x power, I can discern no mark on the shining smoothness of the store.

How lucky! here I am holding in my hand the little cave with its pudding and feeding larva, and what an opportunity to study its development. You see, I want to place this in a glass tube, darkened with a black photographic paper sleeve, so that I may determine the time taken to eat the store, the weaving of the cocoon, the period of metamorphosis, and the season when the imago emerges. Then there is the sex to be considered.

While I am preparing to carry out my plans, the wind howls round to the south-west and down comes a drenching shower. The tiny pudding rolls over in my hand—???. I say some hard things, for the soft larva is crushed into a speck of moisture. The rain pours down, and I am soaked; but I cannot leave the place without filling in the excavations, for someone would be sure to fall in, and perhaps break a limb. In any case, the municipal authorities, who are not nature students, would most assuredly prosecute me if they witnessed my digging, so I must stay and make things "ship-shape" again.

But I am cold and wet, also hungry, and predisposed—just a little—to bronchitis, so I hurry home as fast as I am able while laden with a spade, specimen tubes, and other impedimenta of the naturalist's game. I am no sooner arrived than the rain ceases, and the sky is once more clear and blue. That is the typical spring weather of my coast line.

There is one point that prompts me to refer again to Fabre's *Halictus*. As you are all aware, his bees did not close up the cell until the larvae had eaten the whole of the store, and were about to undergo the metamorphic change. Fabre thought that the cells were left open, so that the mother might supplement the ration, which seemed scanty when compared with the supply of other wild-bees.

Of course, it might be so, for *Apis*, the Honey-bee, continues the feeding of the larvae with super-food for several days before sealing the cells, and the maternal solicitude of *Halictus* may equal that of the *Apis*.

The cell of the Australian Sand-hopper Bee is often closed for several days, and she, too, may rival the large French *Halictus* in her continued care for her family. However, many of these bees carry pollen during the whole of October, and this seems anomalous, because I find only one chamber at the bottom of the shaft, and the total store only amounts to about three Honey-bee loads.

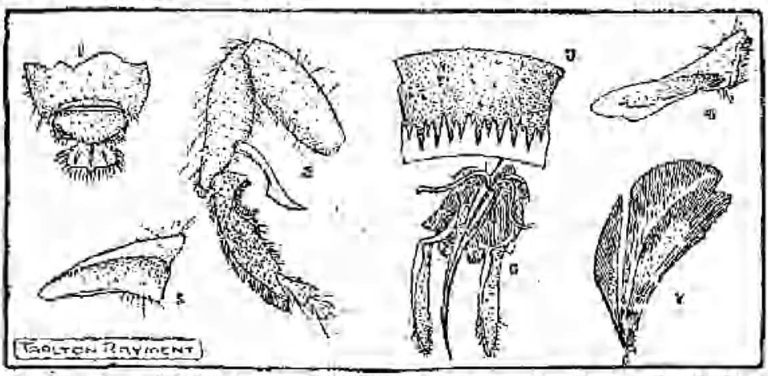
The explanation may be that only a very few trips are made during the day. In three hours I note only one voyage by this bee; then she spends an hour or two in the cell. Unlike the "Black and Tans,"* this one is seldom on "watch" duty, nor am I able to find two bees using one tunnel. Each to its own is the rule with this *Halictus*. Only rarely does she watch at the entrance; is not the grand-mother, and, in this respect, she departs from the Frenchman's bees.

I repeat, I am utterly unable to obtain more than one pudding in one shaft, but I doubt if the Sand-hopper makes more than two shafts. However, up to the closing of the nests, I do not see any males, and although there are unavoidable gaps in my observations, I feel that the mothers I saw digging and provisioning nests were a generation of females that are the progeny of a fertile mother carried over the winter in a state of hibernation.

I know of only one large Sand-hopper Bee colony, and it is so mixed up with that of another bee of very similar form that I have to be extremely careful in my observations. However, by the end of October, all the "Sand-hoppers" shafts are closed and buried beneath an avalanche of loose fine sand.

But when November opens, another generation of *victoriellus*, is digging for dear life, and I see both males and females on the Veronicas, the latter gathering fair loads of cream pollen. About the time the famous "Cup" attracts its hundreds of thousands, these bees celebrate the day by many "marriages" which all take place in the burrows.

**Halictus mesembryanthemi*, Ckll, the life history of which is given in a proposed book.



1, The beautiful *labrum* of *Halictus intermedia*, Raym. † 2, Portion of front leg, showing antenna brush and peg, *Halictus intermedia*, Raym. † 3, Portion of abdominal dorsal plate, showing how the coloured chitin impinges on the hyaline margin. † *Halictus intermedia*, Raym. 4, Mandible of *Halictus raymenti*, Ckll. † 5, Mandible of *Halictus intermedia*, Raym. † 6, The weak sting and palpi of *Halictus raymenti*, Ckll. † 7, The flexor muscle of the mandible of *Halictus tarltoni*, Ckll. †.